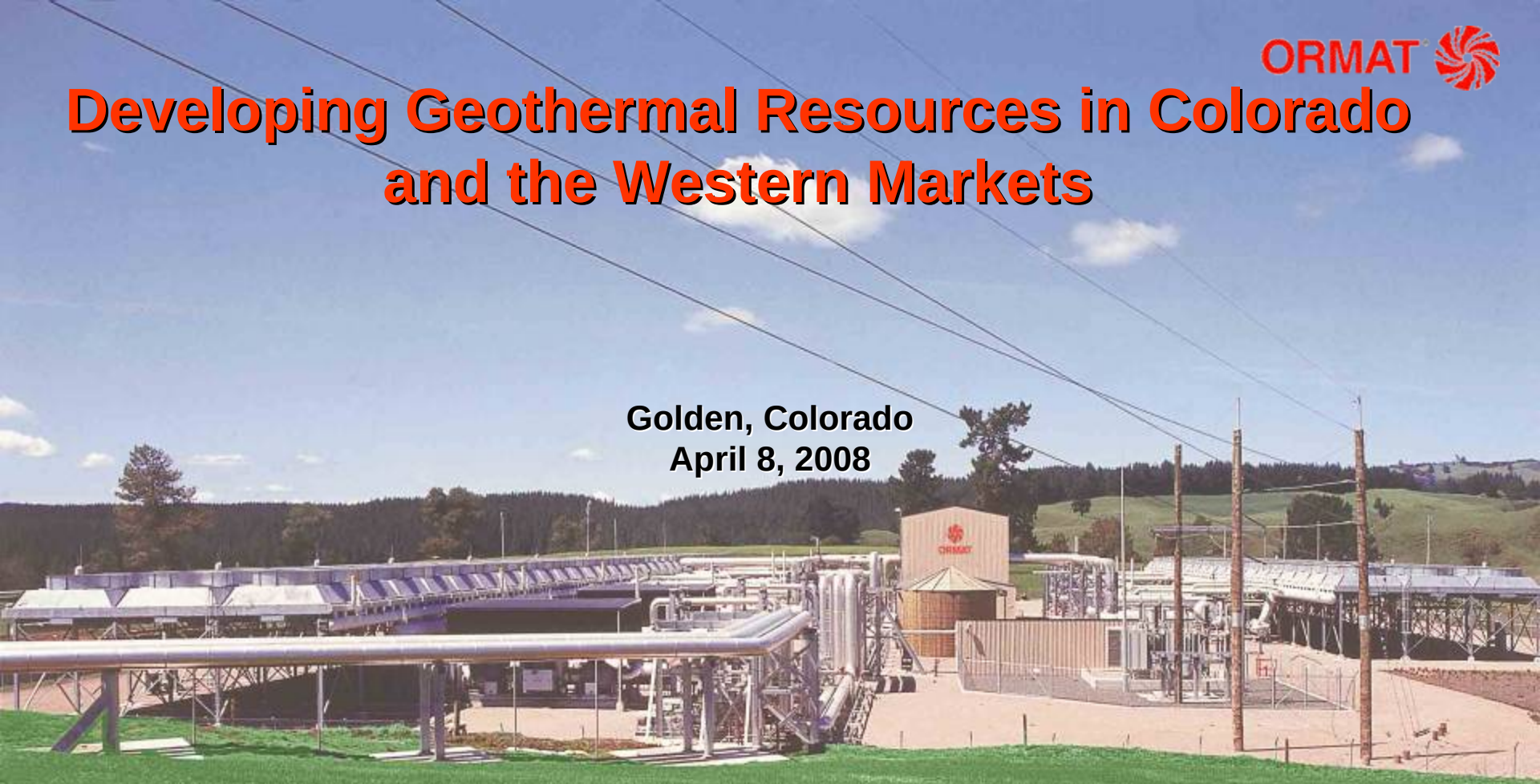
Developing Geothermal Resources in Colorado and the Western Markets



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Ormat: Innovative Power Plant Technology

- Vertically-integrated company active in the design, engineering, supply, installation, support & operation of renewable & sustainable energy products and projects since 1965

- Four decades of experience developing modular power plants from 0.2 MW to 130 MW for geothermal, recovered energy generation (REG), biomass, solar, and re-powering/rehabilitation of existing plants

- Supplied over 950 MW of geothermal and REG power generation in 23 countries, about half of the supplied MW are currently owned by Ormat

- The only pure play geothermal and renewable energy company supplying equipment and technology to utilities and developers as well as owning and operating geothermal projects world wide

Ormat's World Wide Presence
Over 900 MW of Geothermal Power Plants

57 MW Ormesa Binary Geothermal Complex, California

30 MW Puna Combined Cycle Geothermal Power Plant, Hawaii

125 MW Upper Mahiao Combined Geo Power Plant, Philippines

40 MW Heber Geothermal No. 2 Binary Power Plant, California

20 MW Burdette Binary Geothermal Power Plant, Nevada

115 MW Mokai Combined Geo Complex, New Zealand

Plug and Play On Site Geothermal Power

Pre-Packaged Equipment Supply for Self Construct

Ormat supplied equipment for remote and rural applications

First commercial geothermal application in Nevada. 800 kW OEC. with power supplied to Sierra Pacific Power Co.
24 years of operation.

800 kW Wabuska Geothermal Power Unit, Nevada.

Supplying local electrical power and energy for crop drying and cold storage since 1989.
19 years of operation.

300 kW Egat Geothermal Power Plant, Thailand

Owner installed plant using Ormat supplied equipment, documentation and technical assistance.
4 years of operation.

1.8 MW Oserian Geothermal Power Plant in Naivasha, Kenya

250 kW air-cooled geothermal CHP plant generating electrical power as well as district heating, by utilizing a low temperature geothermal resource.
7 years of operation.

250 kW Geothermal Power Unit at Rogner Hotel & Spa, Bad Blumau, Austria

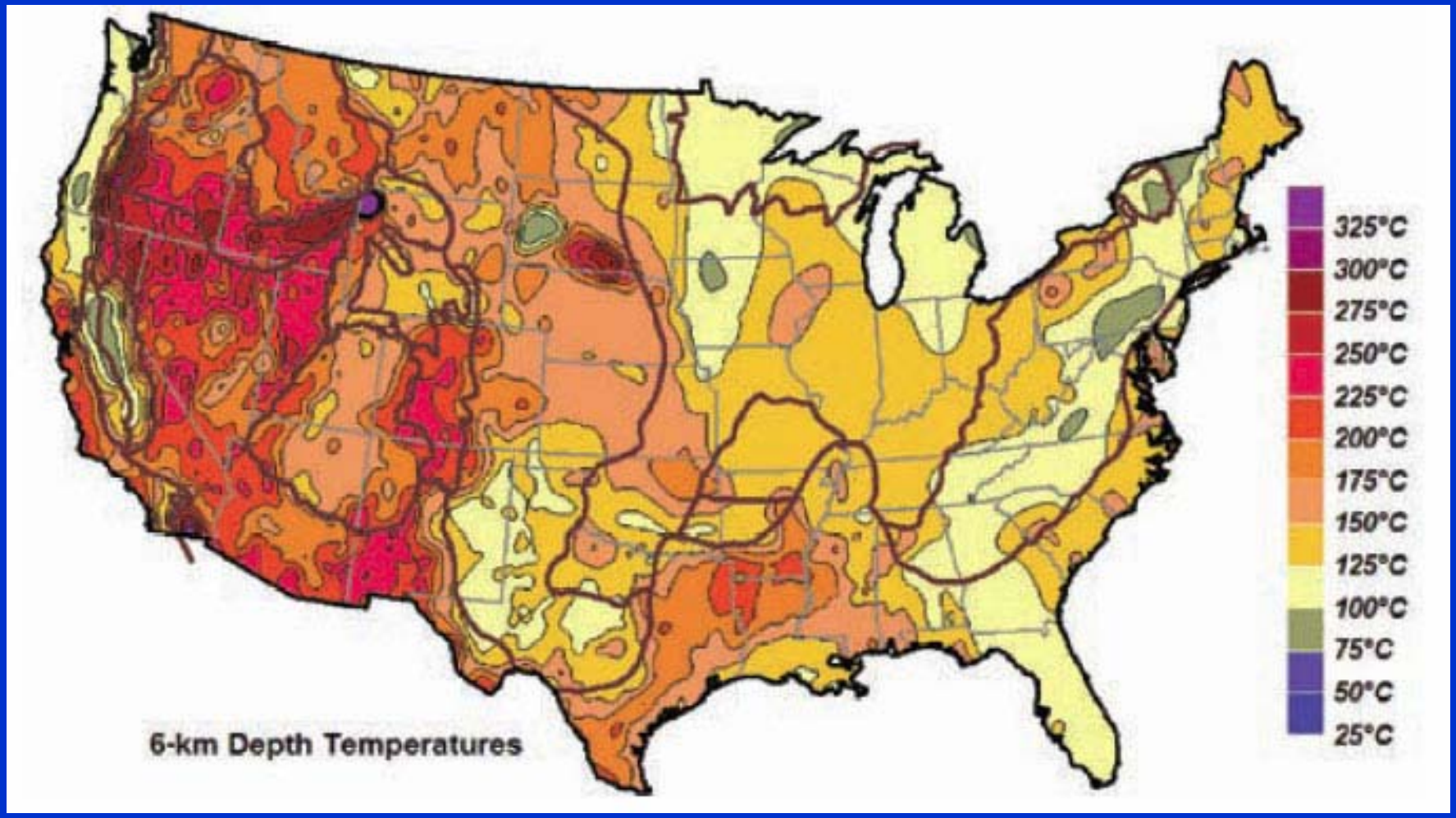
Presentation Purpose

- This presentation will examine the power market in Colorado and general issues related to how geothermal fits into power markets in the Western U.S.

- The presentation will focus on:
  - Colorado's power market
  - Colorado's geothermal potential
  - Colorado's needs in order to facilitate geothermal development
  - Key issues for geothermal throughout the West
  - General power market trends throughout the West

How extensive is the U.S Geothermal Resource?

Estimated Earth temperature at 6-km (3.7-mile) depth. Southern Methodist University (SMU) Geothermal Laboratory. Source – National Renewable Energy Lab (NREL)

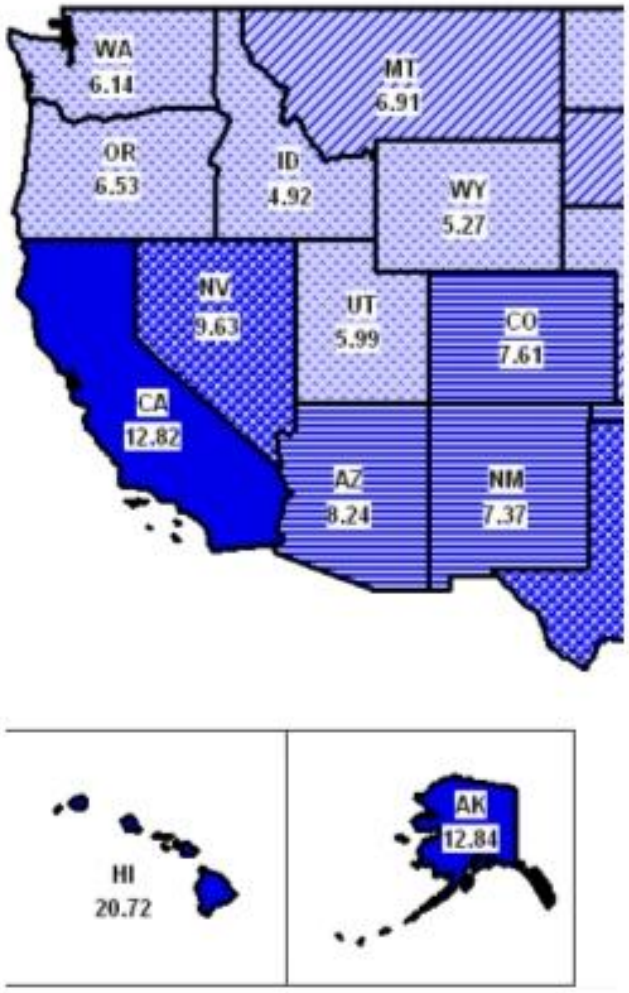


Status of the U.S. Geothermal Power Market

Over 60 Geothermal power plants in 6 U.S. states: (AK, CA, HI, ID, NV, UT)

- Geothermal electricity has been produced in 9 states: (NM, OR, TX)
- At least 9 states expect to have plants by 2010
- Ormat owns and operates plants in 3 U.S. states, and Ormat has installed plants in 5 U.S. states that currently operate
- There is potential for geothermal power development in all 13 Western States

Average Retail Electricity in the Western U.S. in 2006



Source: Energy Information Agency

Summary of development issues in Colorado

Ouray, Colorado. Photo by Daniel Fleischmann

Colorado's Energy Market

Fossil Fuel production

- 11th in domestic crude oil production in 2006
- 7th in domestic coal production in 2006
- Produced over 6% of domestic marketed natural gas in 2006

Electricity Generation

- Over 2/3^{rds} of Colorado's electricity is generated from coal, nearly ¼ from natural gas
- The rest comes primarily from hydro and wind
- 1,066.75 MW of installed wind capacity by year-end 2007
- Electricity generation only slightly higher than electricity consumption

Electric Utilities

- Xcel Energy is the principal investor-owned utility (IOU) in Colorado, with 54.7% of retail power sales
- Other primary electricity providers include, Munis in Colorado Springs and Fort Collins, WAPA, and Tri-State

Power prices

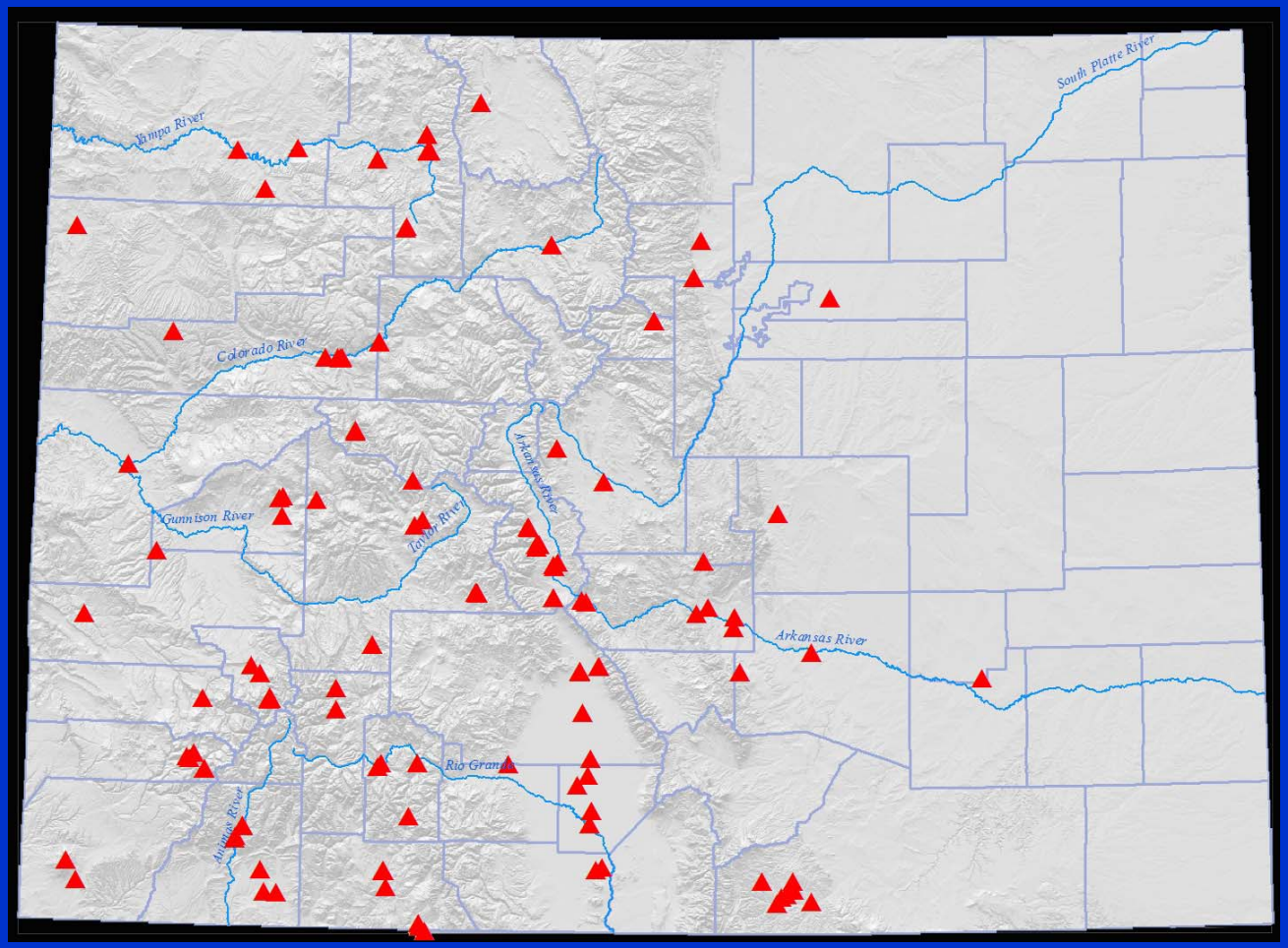
- Colorado power prices are highest in the Rocky Mountain region, but below the U.S. average

Colorado's Policies

- Renewables Portfolio Standard
  - IOUs - 10% of retail electricity sales during 2011-2014; 15% during 2015-2019; and 20% by 2020.
  - Each rural cooperative and each municipal utility serving over 40,000 customers must provide 3% of its retail electricity sales during 2011-2014; 6% of its retail electricity sales during 2015-2019; and 10% by 2020, with no opt-out provision
- Clean Energy Fund
- Efforts at expanding transmission access to renewable energy sources

Colorado Hot/Warm Springs and Wells

Source: Colorado Geological Survey



Colorado's Geothermal Potential

- Colorado Resources often overlooked (shallow gradient data thrown off by mixing with alluvial deposits).
- 106 hot springs and 63 geothermal wells ranging in temperature from 20ºC to 83ºC (68ºF to 181ºF) across the state.
- Historical limitations to geo-power development in Colorado include low energy costs, minimal drilling, and preference for geothermal heating projects for recreation and commercial business.
- Colorado's geology is conducive to high temperature geothermal systems.
- Regionally high heat flow (quantity of heat).
- Temperatures over 149°C (300°F) have been measured in oil and gas wells. Up to 20 wells in the San Juan Basin have temperatures of 121°C (250°F) or more between 7,000-9,000 feet deep.
- The history of mining in Colorado may reveal more data about the geothermal resource in the Rocky Mountains. Furthermore, the fact that mining has occurred creates a precedent for development in these areas.
- Geochemical data, geophysical data has identified several locations with potential for economical development of binary power plants.

Colorado's Needs (based on what has worked in other States)

- **Resource characterization**
  - Existing studies have identified potential geothermal target areas, and next steps need to be taken to characterize the resource.
  - Rather than re-assessing old data, promising geothermal target areas could be subjected to studies not covered in the past. Gravity, magnetics, resistivity, remote sensing, temperature gradient drilling, and even slim holes are essential to moving resource characterization forward.

- **Utilize US DOE support for Industry Coupled Drilling – similar to GRED**
  - Geothermal Resource Exploration and Development (GRED) program initiated by USDOE in 1999
  - GRED provided funding support and technical assistance for exploration and development efforts at 22 sites in 7 states (Alaska, Arizona, California, Idaho, Nevada, New Mexico, and Utah).
  - Budget of $12.5 million from 1999 through 2005.
  - Resulted in 2 completed power plants.
  - Expansion of U.S. geothermal facilities from 4 states to 6 states.
  - 12 projects under development.
  - Colorado needs a GRED project of its own.

- **Leasing and permitting**
  - Critical to identify relevant state and federal agencies involved with leasing and permitting of geothermal projects.
  - Interagency coordination will be imperative to enable projects to move forward.

- **Outreach to the public**
  - Critical to bring relevant civic and environmental groups into the discussion of how to design projects that reduce impact on the local environment.
  - Critical to educate the public on the environmental benefits of geothermal power, and the environmental impacts they offset.

Key issues throughout the West

- Federal policies
- State policies
- Resource characterization
- Leasing and permitting
  - Streamlining
  - PEIS progress
  - Federal lease sales
- Transmission planning
  - to incorporate more renewable power into the grid

Other applications that may expand geothermal to other markets

- Co-production from oil wells and geopressured gas wells
  - California, Gulf Coast, Rocky Mountains, Northern Great Plains
- Engineered Geothermal Systems (EGS)
  - Expand existing geothermal fields.
  - Hot rocks and deep geothermal resources across the U.S.
- Off-Grid applications*
  - Aluminum Smelting
  - Alternative fuels
  - Hydrogen Production
  - Industrial drying
  - Local power use
  - Desalinization

**Generally applicable in hydrothermally active areas*

Looking ahead to the Future

Three “P’s” and an “R”

Renewable energy markets are being driven by:

- Population
- Power Prices
- Pollution
- Reliance on Energy Imports

All 4 of these affect California. Hawaii and Nevada are particularly reliant on energy imports.

What about Colorado? - Let’s discuss